EMS Annual Meeting Abstracts
Vol. 15, EMS2018-855, 2018

Assessing the EUSTACE estimates of air temperature from satellite and their uncertainties: selection of reference data and validation results.

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As part of the EUSTACE (European Union Surface Temperature for All Corners of Earth) project estimates of surface air temperature from satellite with uncertainties have been made for land, ocean and ice surface domains using skin to air relationships derived within the project. The air temperature estimates are gridded daily temperature statistics. These from-satellite data are being used, along with in situ data, as inputs to a global air temperature analysis which will span the period from 1850 to present day.

This paper describes the selection of reference in situ air temperature observations for validation of the from-satellite and analysis air temperature estimates and the results of validation of the from-satellite data and their uncertainties. The in situ data used in the validation are independent of the data used in the derivation of the skin to air relationships and the inputs to the analysis. Also, in order to maintain transparency we have only used in situ data that are publically available.

The selection of in situ stations over land is particularly complex as ideally we would have all climate regions and all landcover types represented in the reference dataset. The ice domain presents a different challenge due to the low number of observations available.

We show global validation results and results broken down by region for each season. Over land the results are stratified separately by landcover class and by elevation. We find biases to vary with landcover type and with season. Biases are larger at very high elevations. Over ocean we examine variation with latitude and find biases to vary little with latitude. Over ice we stratify the results by ice concentration.

The validation shows the EUSTACE air temperature estimates to have very small biases of a few tenths of a kelvin with robust standard deviations of less than 1 K over the ocean and around 3 K over the land and ice domains. Biases are larger over land surfaces where the skin-air temperature differences can be over 15 K.
The uncertainty estimates are validated by comparing a model which takes into account the uncertainty in the in situ data and the uncertainty in matching a station point value with a gridbox average. Results over land, ocean and ice show the EUSTACE uncertainty estimates agree well with the modelled values.